

FAST TRACK REPLACEMENT OF THE JEFFERSON STREET BRIDGE

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Abstract

On November 27, 2007, a tanker truck carrying a full load of fuel overturned on Route 54 in Jefferson City, Missouri. The resulting fire severely damaged the Jefferson Street Overpass Bridge. This paper presents the actions taken by the Missouri Department of Transportation (MoDOT) to replace the overpass on a fast track. The accident, MoDOT's immediate response and the subsequent design and construction of a replacement structure on an accelerated schedule are described.

Introduction

Dark, thick smoke rising into a gray, winter sky roused the curiosity of observers in Jefferson City, Missouri. The cause of the smoke had prompted the usual rapid response of the city's emergency workers. Little did workers at the Missouri Department of Transportation know while watching the rising column of smoke from their office windows, but in unprecedented ways they would be asked to respond as well.

On the afternoon of Thursday, November 27, 2007, a tanker truck carrying eight thousand gallons (30.3 cubic meters) of fuel including gasoline, diesel and ethanol overturned on a curve on United States Highway 54, a major route through the city. The ensuing fire incinerated the truck in a blaze made especially high in temperature due to the presence of the ethanol (Figures 1 & 2). Sadly the crash and fire were not survivable for the driver of the truck. The burning fuel carried fire into the storm sewer system, ditches and down the slope of the roadway. In the path of the river of fire was the Jefferson Street Overpass.

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FIGURE 1

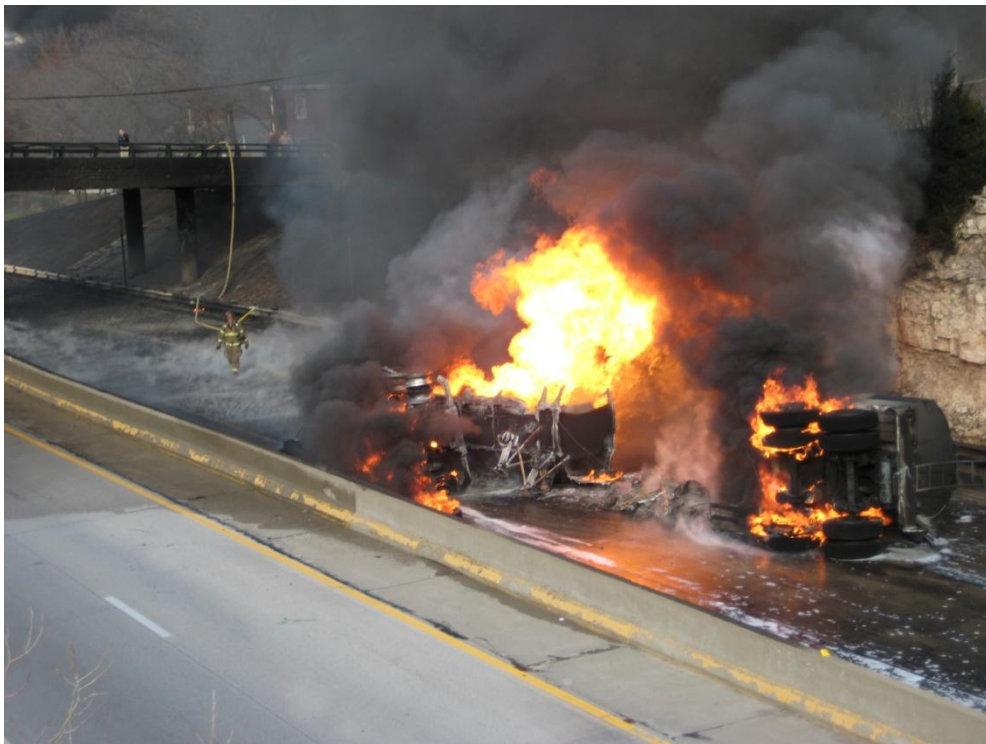


FIGURE 2

Emergency Response

After the blaze was successfully extinguished, MoDOT personnel were ready to respond to the damage to the highway infrastructure. The accident and fire had immediately forced the closure of Route 54. It was also necessary to close Jefferson Street at the site of the overpass. Both District and Central office personnel were dispatched to evaluate the situation. Among those taking part were the District Maintenance Engineer, District Maintenance Superintendent, State Bridge Maintenance Engineer and a Bridge Inspection Technician. They found damage to Route 54 was mostly to incidental items including signs, guardrails and median barrier curb (Figure 3). So after clean up, Route 54 could be reopened. The damage to the overpass was more critical and Jefferson Street remained closed.



FIGURE 3

Bridge Inspection

The overpass (Figure 4) was a four-span, concrete, voided-slab bridge about 184 feet (56.1 meters) in length. The span lengths were 31 feet, 54 feet, 52 feet, and 47 feet (9.4 meters, 15.5 meters, 15.8 meters and 14.3 meters). The intermediate bents consisted of a

reinforced concrete beam on two round columns with spread footings for the foundations. The abutments were reinforced concrete beams with concrete diaphragms. Abutment No. 1 had steel H-piles for a foundation, and Abutment No. 5 had columns and spread footings. Evaluating the damage and deciding what to do with the structure was the next step.



FIGURE 4

A cursory inspection was performed by the State Bridge Engineer on the night of the incident. His initial recommendation was for bridge replacement. The following day an in-depth inspection was performed by the District Bridge Engineer, a Bridge Inspection Engineer and a Rating Engineer. Sounding of the under deck was performed by hammer and rough concrete strengths were determined with a Swiss rebound hammer. The inspection was hampered by the presence of an asphalt chip seal wearing surface and the damage to the under deck caused by the fire.

The worst findings were heavy delamination and severe spalling with resulting exposed reinforcing steel in the columns at Intermediate Bents No. 2 and No. 3 and in the under deck of the north half of span two (Figure 5). The north half of the under deck in span two also was severely scaled (Figure 6). Other damage included a handrail bent by the heat of the fire and melting of the asphalt chip seal (Figure 7). As a result the deck and superstructure were rated down from a seven to a five on a scale of nine. The substructure

was rated down from a seven to a three. Based on the inspection, the bridge was kept closed.



FIGURE 5



FIGURE 6



FIGURE 7

Repair versus Replacement

Next a decision had to be made whether the bridge could be repaired or should be replaced. The main arguments for repair were the shorter time and lower cost compared to replacement. The case for replacement was stronger. The extent of the damage was great and could not be easily repaired. The severity of the damage and the reliability of potential repairs were uncertainties. There were concerns that fracture planes would develop along the lower mat of reinforcing steel. Additionally, the durability of the bridge was reduced. The main consideration, as always, was safety of the travelling public. The capacity of the bridge to carry Jefferson Street traffic was uncertain. Route 54 underneath the overpass is a principal arterial with an average daily traffic of 14,000 vehicles. An urgent concern was the danger of falling debris onto the high volume of traffic passing below the damaged bridge.

On November 29, two days after the accident, it was decided to replace the bridge. It was also decided a typical design and construction schedule would not be an acceptable pace. Exposing Route 54 traffic to the potential of falling debris for months was deemed unsafe. Nor was demolishing the bridge immediately and rebuilding it on a normal schedule a viable option. Jefferson Street carries 12,000 vehicles a day and is an important route to Jefferson City businesses and a hospital. The economic impact of the route not being open any longer than absolutely necessary was significant. So along with the decision to replace the bridge, a decision was made to do so at a greatly accelerated rate.

Design and Plans Production

MoDOT's Bridge Division had already begun to assemble a design team to start designing a replacement structure the day after the accident. Design decisions were made to facilitate accelerated construction where possible. The best option for the superstructure was to use voided, prestressed-concrete deck beams with a reinforced-concrete topping. Using prestress components and reusing the existing footings were considered for the substructure. Drilled shafts were also considered for the foundations. In the end it was decided that cast-in-place, three-column bents on new spread footings would be the best option.

Designing the structure quickly was largely accomplished by using a much larger design team than is typically utilized. The managers, designers, technicians and support staff working on the project totaled over two dozen, which is about three times the size of a typical team assigned to a project. The team also worked significantly longer work days than usual. After six-hundred hours of design time, finished bridge plans were complete. With similar efforts by MoDOT's other divisions and district staff, the project plans were ready for an emergency bridge letting on December 4, seven days after the accident.

Bid Process and Preconstruction

MoDOT took on some of the obligations of the contractor prior to the bid to accelerate construction. Some of the key bridge items were acquired by the Missouri Highway Transportation Commission, which oversees MoDOT. Items that needed to be fabricated were purchased ahead of time, and then installed by the contractor. These items included: prestressed-concrete deck beams, reinforcing steel, bearings, fencing and piling. On November 30, MoDOT personnel requested quotes from at least two fabricators for each item to get the best price and shortest delivery time possible. The delivery times requested were very short, but proved to not be impossible, as all of the required items had acceptable quotes approved on December 3.

With completed plans available to potential bidders on December 4 and quotes for Commission supplied items received on December 3, the job was ready for bidding. Bids from six contractors were received, and the bids were opened December 5. The lowest bid of \$878,000 was submitted by Pace Construction of St. Louis. A preconstruction meeting followed on December 6, where the contract was signed. The contract contained provisions for liquidated damages of \$25,000 per day and liquidated savings of \$25,000 per day. There were allowances for two weekend closures of Route 54 and liquidated damages if lanes were not open as specified. Notice to proceed was December 6 and the completion date was specified as January 7. Now it was up to the contractor to meet the tight deadline and the conditions of the contract.

Construction

Pace Construction had to work under challenging conditions. They worked twenty-four hours a day, seven days a week. During the course of the construction they encountered some of the worst weather conditions a Missouri winter can produce. Bitter cold and a large snow storm had to be overcome. When the temperatures improved a little, a large ice storm replaced the falling snow. To pour concrete in such conditions, artificial heating was combined with insulated blankets. To speed curing time, the specifications allowed Type III cement. MoDOT still required all applicable standards and specifications to be followed. To help ensure compliance, MoDOT inspectors operated on the same round the clock schedule and endured the same challenging weather as the contractor. Additional MoDOT personnel were on site as necessary to provide traffic control, allowing the contractor to focus on actual construction.

Under these conditions, demolition began on the evening of Friday, December 7. The contractor utilized the first weekend closure of Route 54. After installing a cushioning layer of sand on the roadway below, the bridge was dropped in large sections (Figure 8). Demolition was largely completed in twenty-four hours. To fully take advantage of the closure, the footings were excavated and poured that weekend (Figure 9). By the end of the first week of construction, columns had been poured at Bents 3 and 4, and the beam cap at Bent 3 was poured (Figure 10). The steel piles at Abutment 5 had also been pre-bored and

driven.



FIGURE 8



FIGURE 9



FIGURE 10

The second week of construction progressed rapidly as well. To speed construction, a change order was made to reuse and reseat the piles at Abutment 1. The rest of the columns and beams of the intermediate bents were completed. The abutments were also complete, thus finishing construction of the substructure. As specified concrete strengths were reached, a second weekend closure was enacted. This allowed for the setting of the precast-concrete deck beams (Figure 11). Route 54 work was also performed. This included pouring a concrete median and barrier curb. Before the week was through, all of the beams had been set and reinforcing steel in the deck was being placed.

Work towards completing the superstructure continued in week three. The rest of the deck steel was placed and tied (Figure 12). The deck and integral concrete diaphragms were poured at the bents and abutments. As the deck cured, reinforcing steel for the barrier curbs was being placed. Attention also turned to the Jefferson Street approaches. Curb, gutter and sidewalk were poured. Existing pavement was removed and the pavement base was prepared to match into the new bridge ends.

The final items were completed in the fourth week. The Jefferson Street approaches were completed, which included roadway paving and fencing (Figure 13). The barrier curbs were poured on the bridge and the bridge pedestrian fence was installed.

Striping was completed on both Jefferson Street and Route 54. Seeding and mulching of any disturbed areas were the final touches. At seven a. m. on January 3, the bridge was opened to traffic (Figure 14).



FIGURE 12



FIGURE 11



FIGURE 13



FIGURE 14

Financing and Cost

The contractor fulfilled the contract five days early, earning them \$125,000 for early completion. Including the contract cost, the early completion incentive and the cost of the commission furnished items, the total project cost was \$1.4 million. To fund the project, the state applied for Federal Emergency Relief Funds. These funds were made possible by an emergency declaration issued by the Governor on December 10. In Missouri's request for federal funds, reimbursement to the federal government would occur if MoDOT was reimbursed by the trucking company. Eventually suit was filed for reimbursement and the case was settled out of court.

Summary

As is often the case, people rise to the challenge to respond to an immediate emergency and then to repair the damage that it causes. Through a combination of creativity, flexibility and determined effort, the Jefferson Street Bridge was replaced in unprecedented time. What typically takes months was designed in seven days and constructed in twenty-eight. By procuring items ahead of time, having design staff on hand for change orders and providing traffic control, the Department provided extra assistance to the contractor. Working around the clock and in weather that usually halts bridge construction; the contractor completed the job to specification, on budget and early. Most importantly a vital link and principal route in the capital city were both safe and open to the travelling public with the least inconvenience possible. Today the ordinary appearing Jefferson Street Overpass gives no evidences of its extraordinary creation, but to those who know, it stands as a testament to what can be accomplished through dedication and cooperation.

Acknowledgements

The authors would like to thank the employees of the Missouri Department of Transportation that made this project a success. We would also like to acknowledge those who provided their insights and recollections of the project's history. We would especially like to thank Bryan Hartnagel and Chris Graham for their assistance and Shaun Schmitz for providing photographs.